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(54) Abstract Title

Percussive drilling apparatus with means for preventing anti-clockwise rotation

(57) The invention concerns a drilling apparatus comprising a drivable drilling spindle (5) with a reversible direction of rotation, which is mounted rotatably in a spindle housing (4) and to the free end of which the chuck body (8) of a drilling chuck (3) is connected with its spindle receiving means (7). The spindle receiving means (7) is connected by way of an axial passage (9) to the tool receiving means (10) formed in the chuck body (8), for the direct transmission of blows of a hammer mechanism which is arranged in the spindle housing (4) and which can be switched on, on to the end of a drill (13) which is clamped in the tool receiving means (10) by displaceable clamping jaws (12), wherein there are provided means for preventing anti-clockwise rotation of the drilling spindle (5) when the hammer mechanism is switched on.

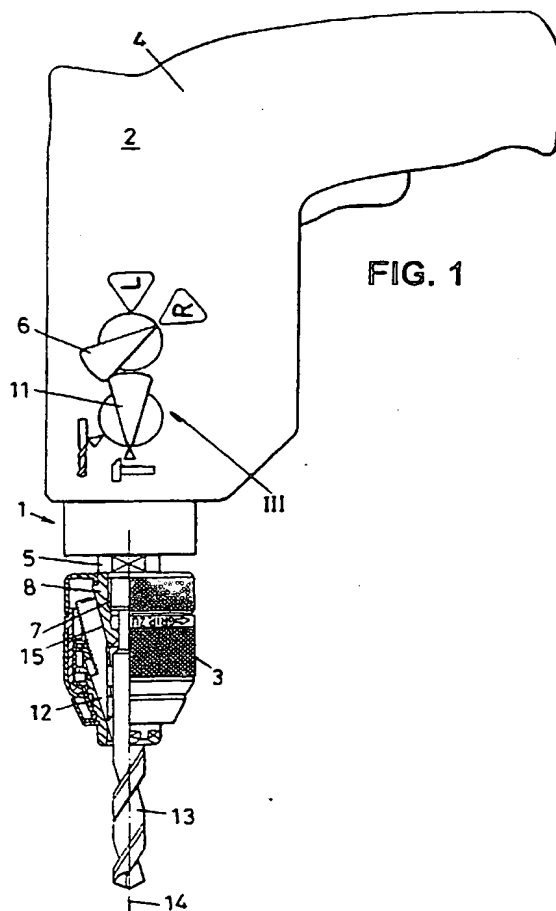
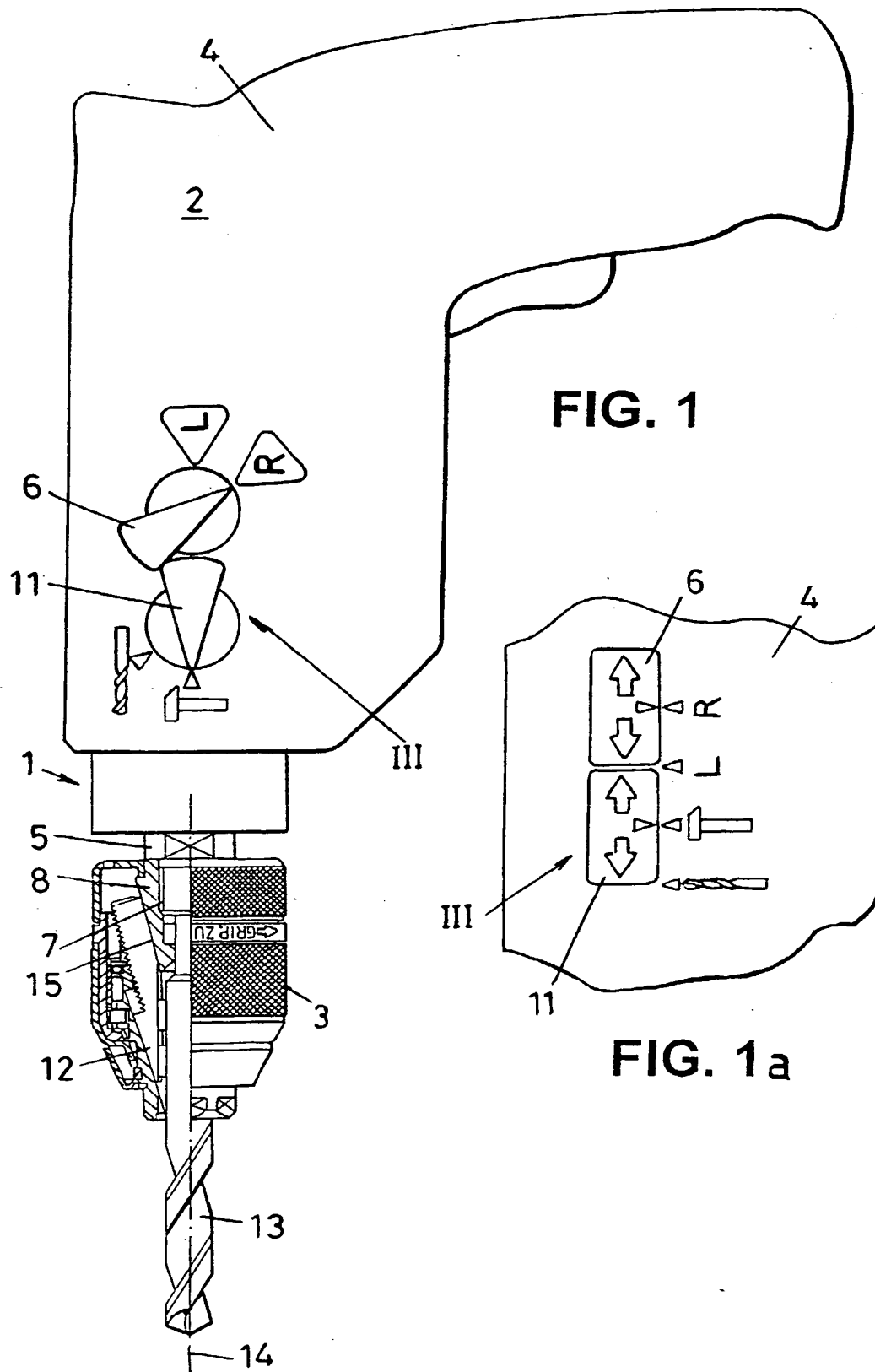


FIG. 1



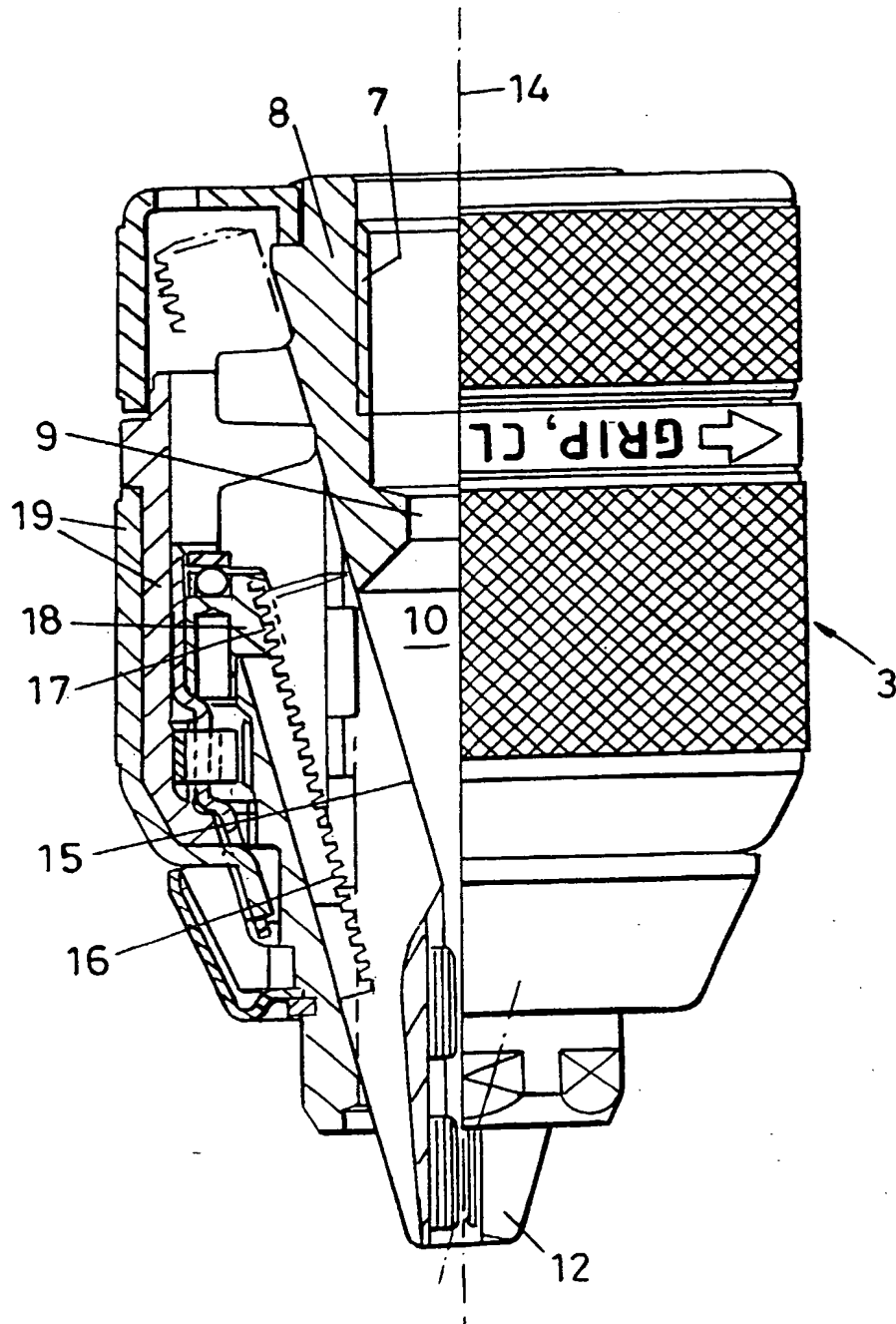
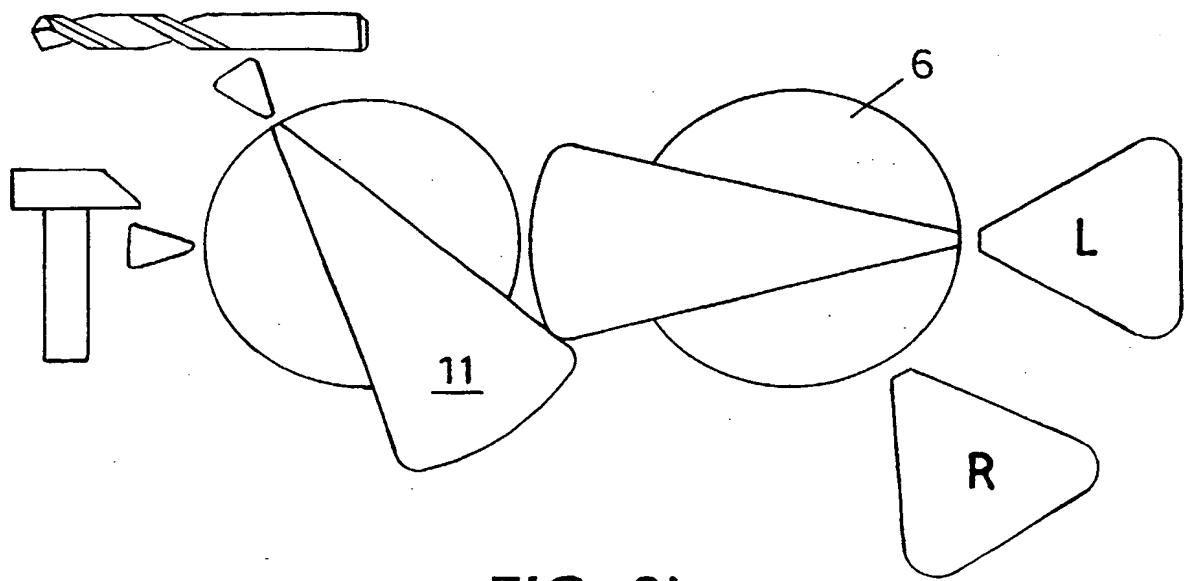
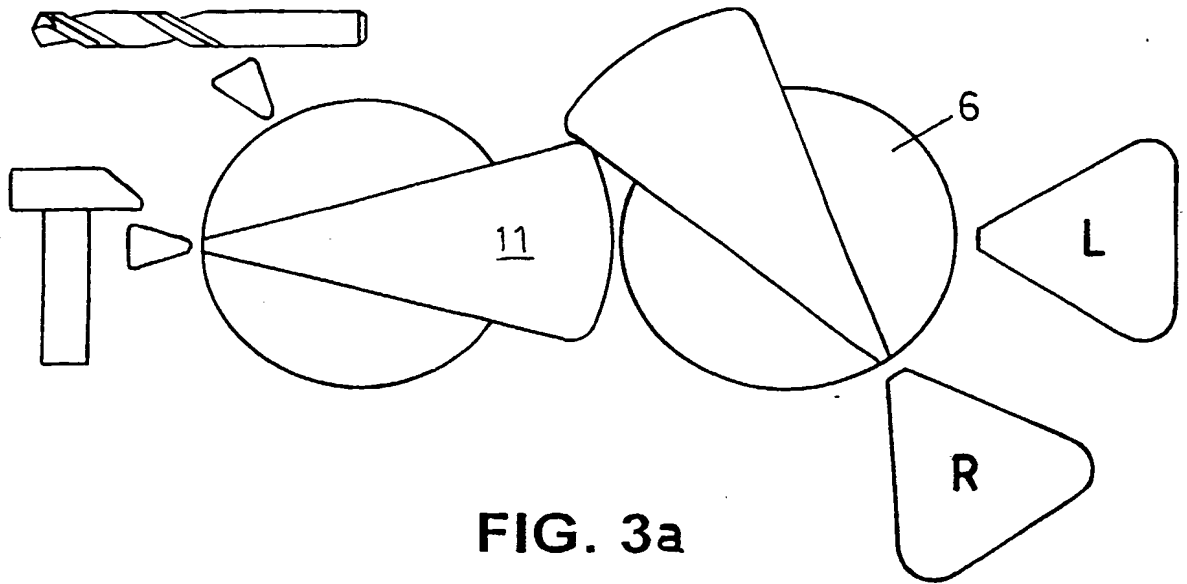
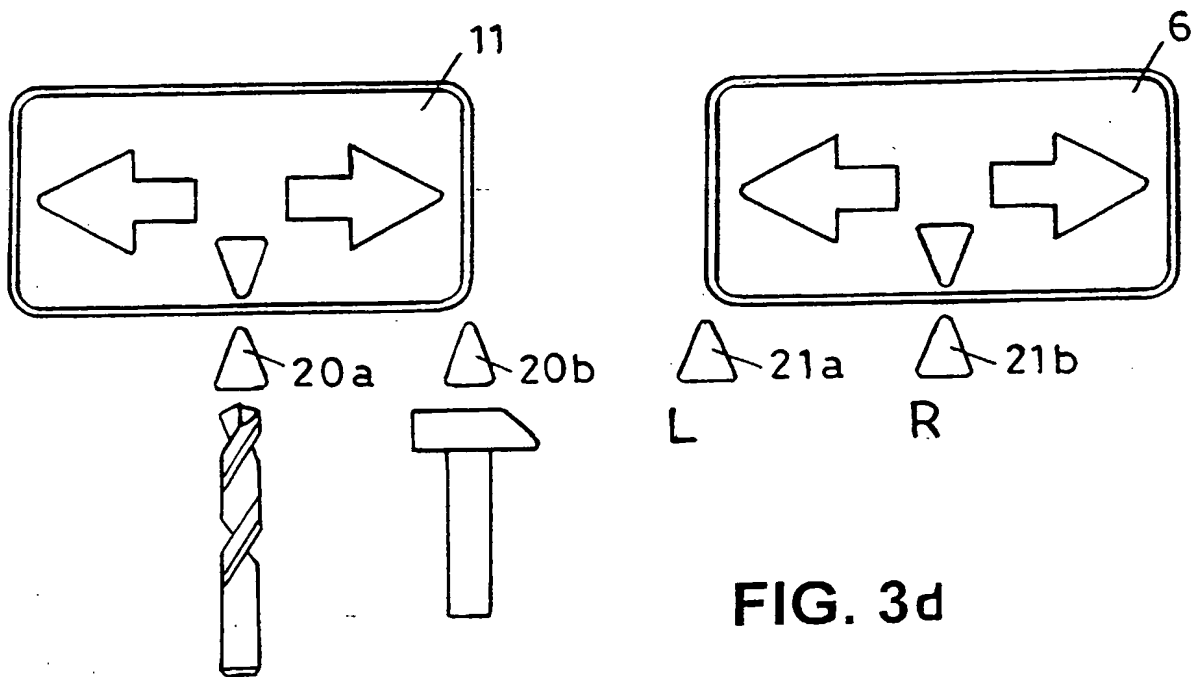
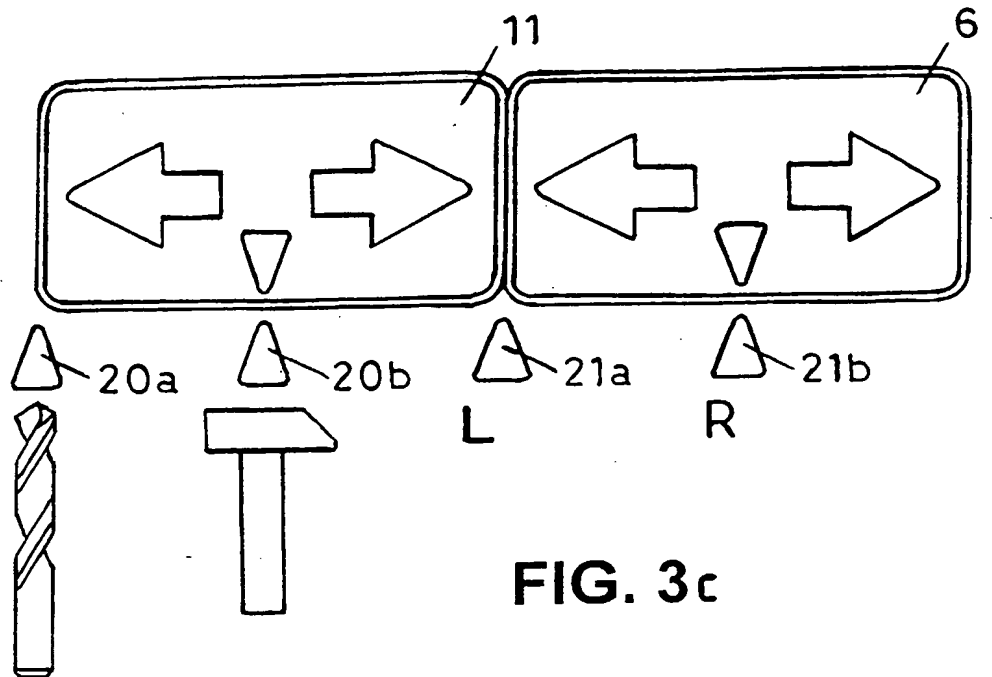


FIG. 2





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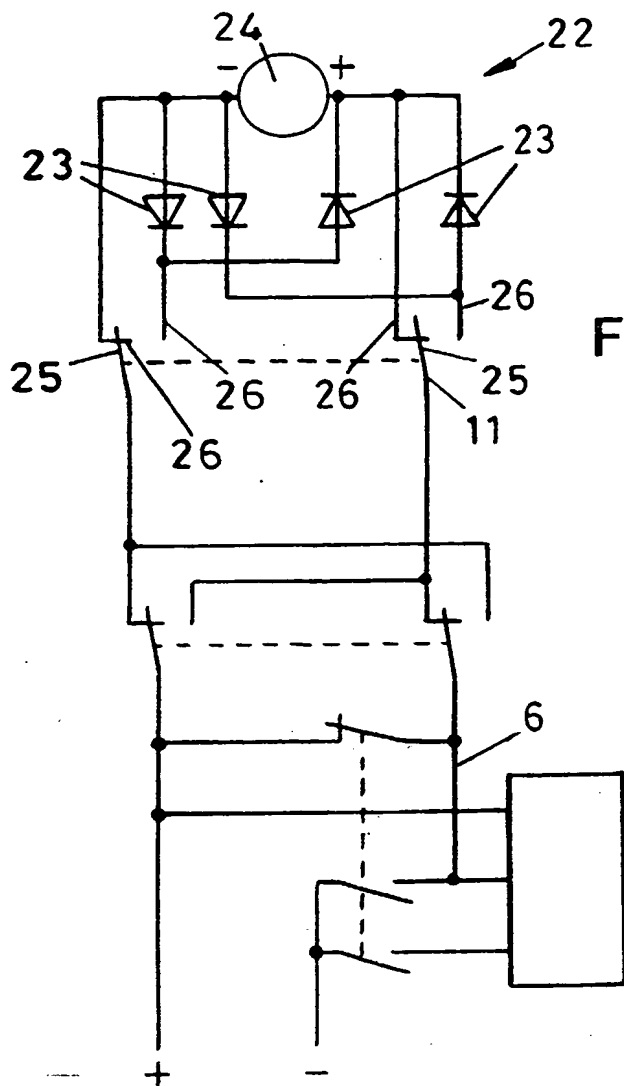


FIG. 4

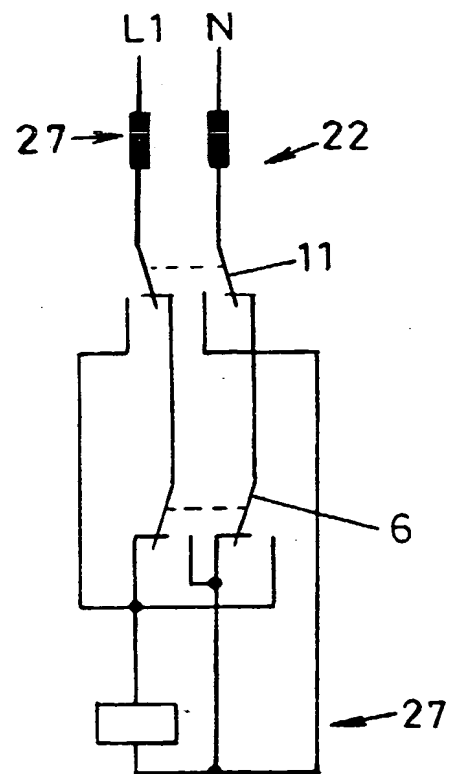


FIG. 5

DRILLING APPARATUS

5 The invention concerns a drilling apparatus comprising a drivable drilling spindle with a reversible direction of rotation, which is mounted rotatably in a spindle housing and to the free end of which the chuck body of a drilling chuck is connected with its spindle receiving means which is connected by way of an axial passage to the tool receiving means formed in the chuck body, for the direct transmission of blows of a hammer mechanism which is arranged in the spindle housing and which can be switched
10 on, by means of the drilling spindle or an anvil guided therein, on to the end of a drill which is clamped in the tool receiving means by displaceable clamping jaws.

Drilling apparatuses of that kind comprising a drilling machine and a drilling chuck are wide-spread in a practical context, with different design configurations being known in particular in regard to the drive. Thus, besides the drilling machines which as
15 their power source use the electrical ac mains with voltages in the range of for example 110 volts to 240 volts, battery machines have also appeared which use a battery as their power source. In that respect the technical development was to the effect that a hammer function has also been integrated in the case of battery drilling machines, in which respect there is generally a trend towards drilling machines of greater power. Such
20 drilling machines, besides the option of switching the hammer mechanism on and off, also afford the possibility of specifically choosing the direction of rotation so that it is possible to envisage a situation, and in practice such a situation has also occurred on the part of inexperienced users in the handyman sector, in which, during the hammer drilling mode, contrary to the general operating instructions, when using drills of small shank diameter, the drill was switched to operate anti-clockwise. That can have the result that
25 the drilling chuck becomes tighter and tighter under the effect of the continuously occurring blows on the part of the hammer mechanism, and therefore the drill is gripped so firmly that it can no longer be released, which, in spite of the improper use involved, is attributed to the drilling chuck as being a defect.

30 The invention is therefore based on the problem of so designing a drilling apparatus of the kind set forth in the opening part of this specification, that the above-indicated disadvantages are avoided and excessive tightening of the drill under the effect of the hammer mechanism does not occur.

In accordance with the invention, in a drilling apparatus of the kind set forth in

the opening part of this specification, that problem is solved in that there are provided means for preventing anti-clockwise rotation of the drilling spindle when the hammer mechanism is switched on.

5 The invention affords the advantage that the decision about an inadmissible mode of operation is taken away from the user who can rely on misuse of the drilling apparatus in that respect being prevented by structural measures. That can be achieved in a particularly simple fashion for example insofar as, when the hammer mechanism is switched on and in a switch position which predetermines anti-clockwise direction, any starting movement of the drilling spindle is prevented.

10 As however the fact that the drilling spindle is blocked can be misinterpreted as a malfunction of the drilling machine or as a defect, an embodiment which is preferred in accordance with the invention is characterised in that the means for preventing the anti-clockwise rotation of the drilling spindle when the hammer mechanism is switched on are provided by means for enforcing clockwise rotation of the drilling spindle when
15 the hammer mechanism is switched on.

An embodiment which is particularly preferred in accordance with the invention is one which is characterised in that the means for enforcing clockwise rotation are embodied by the adjacent arrangement of the two switches which switch the direction of rotation and the hammer mechanism and which, for switching on the hammer
20 mechanism and for switching over the direction of rotation to anti-clockwise rotation, require the same detent position for their corresponding switch position. As the two switches require the same detent positions for switching on the hammer mechanism and for switching over the direction of rotation to anti-clockwise, this excludes an inadmissible combination of modes of operation being selected, as there is indeed only
25 ever one of the two switches which are necessary to implement the inadmissible mode of operation, that can be in that detent position.

It is desirable in that respect if, for the two switches which are displaceable linearly between two respective detent positions, there is a common central detent position out of which, when one switch is moved thereinto, the other switch is displaced.
30 This embodiment affords the user the possibility of switching over at any time from clockwise rotation to anti-clockwise rotation or from the normal drilling mode to the hammer drilling mode, but in that case the simultaneous displacement of the second

switch means that the user cannot select an inadmissible mode of operation, insofar as the respective other switch is necessarily displaced into the detent position required for the admissible mode of operation.

5 Alternatively or in addition it is possible for the means for enforcing clockwise rotation to be embodied by a circuit which forces the electric motor required to drive the drilling spindle to rotate in the clockwise direction when the hammer mechanism is switched on. To resolve the problem that embodiment is not directed to the enforced selection of the correct switch positions, but predetermines the admissible direction of rotation for the drilling spindle independently of the position of the switch for the direction of rotation when the hammer mechanism is switched on.

10 For that purpose, in a drilling apparatus comprising an electric motor which is operated by direct current, in particular in the case of a battery-powered hammer drilling machine, it is provided that, in the circuit which enforces clockwise direction when the hammer mechanism is switched on, the switch for the hammer mechanism is arranged
15 between the switch for the direction of rotation and the electric motor and in the position corresponding to the switched-on hammer mechanism is connected by way of a respective pair of diodes to the lines leading to the electric motor, wherein the pair of diodes upstream of the electric motor involves the opposite forward conducting direction in relation to the pair of diodes connected downstream thereof. This embodiment is distinguished in particular by virtue of the fact that clockwise rotation can be enforced
20 solely by the suitable choice of the position of the switches for the hammer mechanism and for the direction of rotation and by virtue of the use of inexpensive components which are afforded by the diodes, when the hammer mechanism is switched on, while the direction of rotation can still be freely selected when the hammer mechanism is switched
25 off.

In accordance with the invention, in a drilling apparatus comprising an electric motor which is operated by alternating current, in particular in a high-power hammer drilling machine, it is provided that the switch for the direction of rotation is disconnected from the current path when the hammer mechanism is switched on and is bridged over by lines which are arranged parallel to the switch for the direction of
30 rotation and which in turn are disconnected when the hammer mechanism is switched off. This structure is also distinguished in that it is inexpensive to implement without

noticeably increasing the costs of the drilling machine.

In order not to transmit incorrect information to the user due to the misleading switch position, in the embodiments in which an admissible mode of operation is enforced solely by virtue of switching on the hammer mechanism and the apparatus switches over to clockwise rotation in spite of the switch position corresponding to anti-clockwise direction, there is provided a signal device, in particular a light emitting diode, for indicating the reversal in the direction of rotation which is enforced by the circuit.

The invention is described in greater detail hereinafter by means of embodiments illustrated in the drawing in which:

Figure 1 is a side view of a drilling apparatus according to the invention,

Figure 1a shows the detail relating to the switch arrangement of the drilling apparatus of Figure 1 in an alternative embodiment,

Figure 2 shows the drilling chuck from the drilling apparatus, in axial section at the left and as a side view at the right,

Figures 3a and 3b show the detail III from Figure 1 with the two switches for the hammer mechanism and for the direction of rotation, which are displaceable between two detent positions,

Figures 3c and 3d show the detail III from Figure 1a with the two switches for the hammer mechanism and for the direction of rotation, which are displaceable rectilinearly between two detent positions,

Figure 4 is a diagrammatic view of a circuit used in a battery-powered hammer drilling machine for enforcing clockwise rotation when the hammer mechanism is switched on, and

Figure 5 is a view corresponding to Figure 4 of a circuit provided in a hammer drilling machine.

Referring to Figure 1 shown therein is a drilling apparatus 1 which comprises a drilling machine 2 and a drilling chuck 3, wherein the drilling machine 2 has in particular a drivable drilling spindle 5 which is mounted rotatably in a spindle housing 4 and whose direction of rotation can be reversed by a switch 6. The chuck body 8 of the drilling spindle 3 is connected to the free end of the drilling spindle 5, with its spindle receiving means 7. The spindle receiving means 7 is connected by way of an axial passage 9 to the tool receiving means 10 which is provided in the chuck body 8 so that the blows of a

hammer mechanism which is arranged in the spindle housing 4 and which can be switched on by a further switch 11 can be transmitted directly on to the end of a drill 13 which is clamped in the tool receiving means 10 by displaceable clamping jaws 12, directly through the drilling spindle 5 or through an anvil which is axially displaceably guided therein. The displaceability of the clamping jaws 12 which are arranged in guide mountings 15 which are arranged inclinedly with respect to the axis 14 of the chuck and distributed uniformly around the periphery of the chuck body 8 is achieved in the embodiment illustrated in the drawings by means of rows of teeth 16 which are provided on the clamping jaws 12 and into which engages the screwthread 17 of a screwthreaded ring 18 which is guided rotatably and axially immovably on the chuck body 8 and which in turn can be rotated relative to the chuck body 8 by the adjusting sleeve 19. The locking device which is shown in Figure 2 and which is arranged between the adjusting sleeve 19 and the chuck body 8 is known per se and does not require herein further description which is to be substituted by a reference to EP 0 710 518.

What is essential in terms of the drilling apparatus illustrated in the drawing is that there are provided means for enforcing clockwise rotation of the drilling machine 2 when the hammer mechanism is switched on.

In that respect Figure 3 shows a structure in which the means for enforcing clockwise rotation are embodied by the adjacent arrangement of the two switches 6, 11 which switch the direction of rotation and the hammer mechanism and which, for switching on the hammer mechanism and for switching over the direction of rotation to anti-clockwise rotation, switch over the respective other switch 6, 11 into the switch position which is required for proper operation (Figures 3a and 3b). The two switches (Figures 3c and 3d) which are displaceable rectilinearly between two respective detent positions 20a, 20b; 21a, 21b have a common central detent position out of which, when one switch 6 is moved thereinto, the other switch 11 is displaced.

Alternatively or as a redundant safety arrangement it is further possible for the means for enforcing clockwise rotation to be embodied by a circuit 22 which forces an electric motor 24 which is required for driving the drilling spindle 5 to rotate in the clockwise direction when the hammer mechanism is switched on. In the case of an electric motor 24 which is operated by direct current, in particular in the case of a battery-powered hammer drilling machine, it is provided that, in the case of the circuit

22 which enforces clockwise direction when the hammer mechanism is switched on, the switch for the hammer mechanism 11 is arranged between the switch for the direction of rotation 6 and the electric motor 24 and in the position corresponding to the switched-on hammer mechanism is connected by way of a respective pair of diodes 23 to the lines which lead to the electric motor 24, wherein the pair of diodes 23 upstream of the electric motor 24 involve the reverse forward conducting direction in relation to the pair of diodes 23 connected downstream thereof. In this respect Figure 4 shows the circuit in the configuration in which the hammer mechanism is switched off. When the hammer mechanism is switched on the contacts 25 change their counterpart contacts 26 so that a predetermined direction of rotation of the electric motor 24 is always enforced independently of the position of the switch 6 for clockwise/anti-clockwise rotation.

In comparison Figure 5 shows a circuit 22 which is used in relation to a drilling machine with an electric motor 24 operated by alternating current, in particular in relation to a high-power hammer drilling machine, and which is distinguished in that the switch 6 for the direction of rotation is taken out of the current path between the motor armature 27 and the motor winding 28 when the hammer mechanism is switched on and is bridged by lines which are arranged parallel to the switch 6 for the direction of rotation and which in turn are taken out of circuit when the hammer mechanism is switched off.

So that the switch 6 which is operable to set the direction of rotation, in its position of indicating anti-clockwise direction, does not provide the user with incorrect information when in fact the machine is operating in the clockwise direction by virtue of the hammer mechanism being switched on, the apparatus has a signalling device, in particular a light emitting diode, for indicating the reversal in the direction of rotation which has been enforced by the circuit 22.

It is to be pointed out that use of the terms clockwise rotation and anti-clockwise rotation are based on the standard which applies nowadays, but that with appropriate adaptation the invention can also be carried into effect and is useful if the grind of the drills 13 or locking devices in drilling chucks are adapted to drilling machines 2 which rotate in the anti-clockwise direction.

CLAIMS

1. A drilling apparatus comprising a drivable drilling spindle with a reversible direction of rotation, which is mounted rotatably in a spindle housing and to the free end of which the chuck body of a drilling chuck is connected with its spindle receiving means which is connected by way of an axial passage to the tool receiving means formed in the chuck body, for the direct transmission of blows of a hammer mechanism which is arranged in the spindle housing and which can be switched on, by means of the drilling spindle or an anvil guided therein, on to the end of a drill which is clamped in the tool receiving means by displaceable clamping jaws, characterised in that there are provided means for preventing anti-clockwise rotation of the drilling spindle when the hammer mechanism is switched on.

2. A drilling apparatus according to claim 1 characterised in that the means for preventing anti-clockwise rotation of the drilling spindle when the hammer mechanism is switched on are formed by means for enforcing clockwise rotation of the drilling spindle when the hammer mechanism is switched on.

3. A drilling apparatus according to claim 2 characterised in that the means for enforcing clockwise rotation are embodied by the adjacent arrangement of the two switches which switch the direction of rotation and the hammer mechanism and which for switching on the hammer mechanism and switching over the direction of rotation to anti-clockwise rotation require the same detent position for their corresponding switch position.

4. A drilling apparatus according to claim 3 characterised in that a common central detent position is provided for the two switches which are displaceable rectilinearly between two respective detent positions, out of which central detent position when one switch is moved thereinto the other switch is displaced.

5. A drilling apparatus according to claim 2 characterised in that the means for enforcing clockwise rotation are embodied by a circuit which forces the electric motor

required for driving the drilling spindle to rotate in the clockwise direction when the hammer mechanism is switched on.

5 6. A drilling apparatus according to claim 5 comprising an electric motor which is operated by direct current, in particular in a battery-powered hammer drilling machine, characterised in that in relation to the circuit which enforces clockwise direction when the hammer mechanism is switched on the switch for the hammer mechanism is arranged between the switch for the direction of rotation and the electric motor and in the position corresponding to the switched-on hammer mechanism is connected by way of a
10 respective pair of diodes to the lines leading to the electric motor, wherein the pair of diodes upstream of the electric motor is of the opposite forward conducting direction in relation to the pair of diodes connected downstream thereof.

15 7. A drilling apparatus according to claim 5 comprising an electric motor which is operated by alternating current, in particular in a high-power hammer drilling machine, characterised in that the switch for the direction of rotation is disconnected from the current path when the hammer mechanism is switched on and is bridged over by lines which are arranged parallel to the switch for the direction of rotation and which are in turn disconnected when the hammer mechanism is switched off.

20 8. A drilling apparatus according to one of claims 5 to 7 characterised in that there is provided a signalling device, in particular a light emitting diode, for indicating the reversal in the direction of rotation which is enforced by the circuit.

25 9. A drilling apparatus substantially as described herein with reference to the drawings, Figures 1 to 5.



INVESTOR IN PEOPLE

Application No: GB 0114924.4
Claims searched: 1 to 9

Examiner: Gareth Prothero
Date of search: 7 November 2001

Patents Act 1977 Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.S): B4C

Int Cl (Ed.7): B25D 16/00

Other: Online: WPI, EPODOC, JAPIO

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
X	GB 2102718 A (BLACK AND DECKER) See abstract.	1 & 2
X	US 4428438 A (SCINTILLA) See whole document.	1 & 2
X	US 4229981 A (MACKY) See whole document.	1 & 2
X	US 4223744 A (LOVINGWOOD) See whole document.	1 & 2
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